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Unraveling the relationship between trauma types and traffic crash characteristics: an error component logit approach

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The literature in traffic safety modeling traditionally proposes frequency models to examine the probability of occurrence of a traffic crash and/or severity models to investigate the probability of a severity outcome conditional on the occurrence of the traffic crash. Frequency and severity models highlight the factors correlated with the occurrence and the severity of the crashes, but generally do not provide insight into the manifestation of specific traumas (e.g., head, thorax, spine, arms, legs). Understanding the probability of occurrence of specific traumas may prove relevant when evaluating the design of active and passive measures for the reduction of injuries. The current study proposes the analysis of the manifestation of traumas from a holistic perspective by considering their correlation with the characteristics of the crash, the involved vehicles and the implicated road users.

The unit of analysis consists in road users involved in traffic crashes that were recorded by both police and emergency rooms in the province of Funen (Denmark). Data for 5,871 road users were extracted from the police-hospital matched dataset. Information from the police concerns crash location and time, infrastructure characteristics, environmental conditions, road users and vehicles involved. Information from the hospitals concerns the diagnosis of primary and secondary traumas for the road users. An error component logit model allows investigating the probability of occurrence of a primary trauma or the combination of primary and secondary traumas. Indirect utility functions are written for traumas as a function of the characteristics of the crash, the vehicles and the patient, while allowing for correlation across traumas (e.g., correlation across all head traumas).

Results illustrate that traumas are related to the nature of the road users and the counterpart in the crash. For example, when compared to car occupants, pedestrians are more likely to injure their upper and lower extremities, cyclists are more prone to suffer from a head trauma combined with upper and lower extremities, and motorcyclists are more likely to incur in a

trauma to their thorax and spine. The use of seat belts is related to a lower probability of thorax and spine injuries when compared to head and neck injuries, and the state of intoxication by drugs and alcohol is related to a lower probability of the road user to suffer from a trauma to their head, thorax and extremities. Model results show the significance of the correlation between the alternative traumas, thus underlining the importance of accounting for this factor to obtain unbiased estimates. The insight provided by the model suggests that passive safety should not be designed under the assumption of population homogeneity, but according to the assumption of population heterogeneity and the design of situational scenarios. Clearly, not only the road user involved, but also the environmental and situational conditions call for different passive safety measures when the mitigation of the effect of the crash is searched for.